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COMPLETE SPECIFICATION.

Improvements in Aluminium Paints.

We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation, established by Statute, of 1 Tilney Street, London, W.1, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with aluminium-rich paints which consist mainly of aluminium in powder form and which are suitable for application to metal surfaces such as iron, steel or aluminium alloy surfaces.

Aluminium paints which when set provide a film in which there is electrical contact of the aluminium particles with each other and with the metal surface, which contact is necessary to provide a fully protective coating, cannot be obtained when normal manufacturing processes are employed to make the aluminium powder.

This is due to the presence of highly insulating films of aluminium oxide and in the case of aluminium flakes of aluminium stearate, and it is an object of the present invention to provide paints which when spread out on a metal surface, produce coats containing metallic aluminium particles in electrical contact with the metal surface and with one another and which remain in contact when the coat has become hard.

In accordance with the present invention these paints are manufactured by a process which comprises the steps of abrading a metal powder consisting mainly of aluminium wholly or substantially free from anti-pyrophoric lubricants such as a stearate or stearic acid, the abrading being carried on until any insulating film around the particles of the powder has been broken down sufficiently to allow electrical conductivity in the dried paint film, the abrading and all subsequent steps in the process being carried out without the addition of any anti-pyrophoric lubricant and in such a manner to prevent substantially reoxidation of the surface of the aluminium powder, and incorporating the metal powder in a paint composition.

Preferably, the metal powder contains at least 70% by weight of aluminium.

The abrading operation which is usually a conventional grinding or ball-milling or like operation is preferably carried out in a liquid which may be the medium or vehicle of the paint or may be an organic solvent such as a hydrocarbon, for example xylene, which is miscible and compatible with the paint medium. Other organic solvents which may be used include one or more of cyclohexanol, methyl iso-butyl ketone, butanol, iso-propanol, toluene, diacetone alcohol and glycol mono-ethyl ether. A suitable solvent must, in addition to being miscible with the paint vehicle, deter or inhibit the formation of fresh aluminium oxide films.

The metal powder used as the pigment may be a mixture of aluminium powder with a smaller amount of a powder of one or more of other metals such as zinc, cadmium or lead. It is preferable to use an aluminium powder which carries a thin oxide film and has no stearate content. A suitable powder is a 120 mesh B.S.S. powder produced by atomization. Alternatively, the metal powder may be a powdered alloy of aluminium with smaller amounts of other metals and substances such as zinc, magnesium, silicon and/or cadmium.

In order to produce considerable metal particle to particle contact and hence good electrical contact it is important to use a

[*Price 3s. 6d.*]

paint medium which does not stretch too much on drying and sets to a strong matrix, so that the pushing apart of pigment particles may be greatly restricted or prevented. Epoxy resins may be incorporated in the medium for this purpose, either of the two types in which an amide or an amine group brings about the hardening being usable. Polyester and other plastics which do not expand or even shrink on setting may be used for this purpose.

Using aluminium pigment as described above, by incorporating finely powdered graphite in the vehicle, the proportion of pigmentation can be decreased without destroying the electrical conductivity of the paint. The painting properties of the paint can be improved in this way.

In addition, substances of mildly alkaline character such as magnesium oxide or zinc oxide may be incorporated in the paint either to help in the destruction of the existing oxide film or to prevent the formation of fresh oxide (or hydroxide) near the aluminium particles, such as would interfere with the particle-to-particle electrical contact. If zinc oxide is added it should be free from zinc carbonate.

A suitable paint composition A employing as pigment an aluminium-zinc alloy powder containing 5% zinc is as follows:—

500 grams of the pigment moistened with a little xylene;

200 cu. cm. of an epoxy cold-cure resin; and

100 cu. cm. of a resin hardener.

The thinner recommended by the makers of the resin can be added to thin the paint to the right consistency.

A suitable epoxy cold-cure resin is clear lacquer based on Epikote TD 1321 (a Registered Trade Mark) made by Messrs. Lewis Berger Ltd. A suitable hardener is TD 1279 made by Messrs. Lewis Berger Ltd.

The paint can be manufactured by first making up the required amount of pigment into a loose sludge with xylene, which is then well ground in a mechanical mortar for a few hours. The sludge is then transferred to a ball mill (with some extra xylene for rinsing) which is rolled for about one hour. For 100 grams of pigment a suitable mill is in the form of a steel cylinder 17 cm. long, 11 cm. diameter and containing 356 steel balls of 1.3 cm. diameter.

The contents of the mill are then filtered and after the balls have been removed with a magnet, the sludge after rinsing with xylene and further filtering, is thoroughly mixed whilst still damp by grinding with the epoxy resin. The hardener is added before painting in accordance with the manufacturer's instructions.

A paint composition B, alternative to paint composition A and made in a similar manner, is as follows:—

480 grams of pigment consisting of atomized aluminium powder moistened with a little xylene;

10 grams of heavy magnesium oxide;

340 cu. cm. of an epoxy cold-cure resin; and

170 cu. cm. of a resin hardener.

A further paint composition C, similar to paint composition B and made in a similar manner but employing graphite instead of magnesium oxide is as follows:—

480 grams of pigment consisting of atomized aluminium powder moistened with a little xylene;

90 grams of graphite;

520 cu. cm. of an epoxy cold-cure resin;

260 cu. cm. of a resin hardener.

Thinners recommended by the makers of the resin can be added to the paint compositions B and C.

In place of the epoxy resin (and resin hardener) in compositions A, B and C, plasticized polystyrene (with about 25% solid content) may be used in amounts approximately the same as that given for the epoxy resin in the compositions. Xylene or solvent naphtha may be used as the paint thinner.

Aluminium powder ground in a ball mill with 2.5% lead powder, and 25% by weight zinc powder in xylene may be used in the following composition D:—

5 parts by weight of this mixed metal pigment;

2.5 parts by weight of graphite powder;

3 parts by weight of epoxy cold-cure resin; and

0.6 parts by weight of amine-type resin hardener.

This composition should be used with a thinner recommended by the manufacturers of the resin. The resulting paint is designed to give protection in many corrosive environments.

A further composition E may be prepared by grinding commercial aluminium powder (120 mesh B.S.S.) with 25% or more by weight of zinc powder, plasticized polystyrene and xylene in a mechanical mortar until the powder has been sufficiently abraded and reduced in size to give a satisfactory paint. Graphite is then added and thoroughly mixed into the paint which is then thinned with xylene to give it the right consistency for painting.

The composition E is as follows:—

4 parts by weight of aluminium powder;

1 part or more by weight of zinc powder;

2 parts by weight of graphite; and

3 parts by weight of plasticized polystyrene solution (having 26% solid content).

0.5 parts by weight of zinc oxide (free

from zinc carbonate) may be added and the thinner can be xylene or a mixture of xylene and solvent naphtha.

In the various compositions described the proportions of pigment to graphite may be increased if the oxide content (thickness of oxide film) is particularly low while the total amount of pigment and graphite is not materially changed.

WHAT WE CLAIM IS:—

1. A process for manufacturing aluminium-rich paints comprising the steps of abrading a metal powder consisting mainly of aluminium wholly or almost entirely free from anti-pyrophoric lubricants such as a stearate or stearic acid, the abrading being carried on until any insulating film around the particles of the powder has been broken down sufficiently to allow electrical conductivity in the dried paint film, the abrading and all subsequent steps in the process being carried out without the addition of any anti-pyrophoric lubricant and in such a manner to prevent substantially reoxidation of the surface of the aluminium powder and incorporating the metal powder in a paint composition.

2. A process for manufacturing aluminium-rich paints comprising the steps of abrading a metal powder which consists mainly of aluminium wholly or substantially free from anti-pyrophoric lubricants such as a stearate or stearic acid, the abrading being carried on until any insulating film around the particles of the powder has been broken down sufficiently to allow electrical conductivity in the dried paint film, the abrading and all subsequent steps in the process being carried out without the addition of an anti-pyrophoric lubricant and in the presence of an organic solvent to prevent substantially reoxidation of the surface of the aluminium powder and incorporating the metal powder in a paint composition.

3. A process according to Claim 2 and in which the organic solvent is xylene.

4. A process according to either Claim 1, Claim 2 or Claim 3 and in which the metal powder consists of at least 70% by weight of aluminium.

5. A process according to any one of Claims 1 to 4 and in which the metal powder consists of a mixture of aluminium powder with a smaller amount by weight of zinc powder.

6. A process according to any one of Claims 1 to 4 and in which the metal powder consists of aluminium powder.

7. A process according to Claim 6 and in which the aluminium powder is produced by atomization.

8. A process according to any one of Claims 1 to 4 and in which the metal powder is made of an alloy of aluminium with a smaller amount by weight of zinc.

9. A process according to any one of the preceding claims and which comprises the step of incorporating in the paint a cold-setting synthetic resin which does not expand on setting.

10. A process according to any one of Claims 1 to 8 and which comprises the step of incorporating in the paint an epoxy resin or plasticized polystyrene.

11. A process according to any preceding claim and which comprises the step of incorporating graphite powder in the paint.

12. A process according to any preceding claim and in which up to 10% by weight of magnesium oxide or zinc is incorporated in the paint.

13. A paint made by a process in accordance with any one of the preceding claims.

14. A paint having a composition substantially in accordance with any of compositions A, B, C, D or E herein before described.

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PROVISIONAL SPECIFICATION.

Improvements in Aluminium Paints.

We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation, established by Statute, of 1 Tilney Street, London, W.1, do hereby declare this invention to be described in the following statement:—

The present invention is concerned with paints which contain aluminium in powder form and which are suitable for application to iron or steel articles.

Satisfactory aluminium paints for this purpose are difficult to produce as the electrical contact of the aluminium particles with each other and with the iron and steel, which contact is necessary to produce a protective coating, cannot be obtained when normal manufacturing processes are employed to make the aluminium powder. This is due to the presence of highly insulating films of aluminium oxide or stearate, or both—according to the actual mode of manufacture used.

The purpose of the present invention is to provide paints which when spread out on an iron or steel surface, produce coats con-

taining metallic aluminium particles in contact with the iron or steel and with one another and which remain in contact when the coat has become hard.

In accordance with the present invention, pigments for these paints are obtained by a process which involves the grinding of commercial aluminium or an aluminium-zinc-alloy powder (preferably containing 5—30% zinc) of suitably low oxide-content and very low stearate content in a liquid, which is preferably a hydrocarbon such as xylene.

It is preferable to use as raw material, an aluminium powder which carries a very thin oxide film. A suitable powder is a 120 mesh B.S.S. powder produced by atomization.

It is convenient for the liquid chosen to be miscible with the vehicle of the paint. The grinding process is preferably carried out in a closed ball mill and from the original roughly spherical particles, large or small flakes, depending on the milling time, can be obtained in this way. Furthermore, if desired, these flakes can later be converted into particles having a more spherical form by grinding in a mortar.

Using aluminium pigment prepared as described above, by incorporating finely powdered graphite in the vehicle, the proportion of pigmentation can be decreased without destroying the electrical conductivity of the paint. The painting properties of the paint can be greatly improved in this way.

The amount of graphite required to be incorporated varies in accordance with the thickness of the oxide films and if aluminium powders having very thin oxide films are used the addition of graphite may be wholly or partially dispensed with.

In addition, substances of mildly alkaline character such as magnesium oxide or zinc oxide may be incorporated in the paint either to help in the destruction of the existing oxide film or to prevent the formation of fresh oxide (or hydroxide) near the aluminium particles, such as would interfere with the particle-to-particle electrical contact.

By choosing as the vehicle a substance which will harden to give a strong matrix, the pushing apart of pigment particles may be greatly restricted or prevented. Epoxy-resins are suitable for this purpose, either of the two types in which an amide or an amine group brings about the hardening being usable.

A suitable paint composition (A1) employing aluminium-zinc-alloy powders containing more than 5% zinc and a low oxide content of not more than about ¼% is as follows:—

5 parts by weight of aluminium-zinc-alloy flakes.
2.5 parts by weight of graphite powder.
3 parts by weight of epoxy cold-cure resin.
0.6 parts by weight of amine-type resin curer.
0.5 parts by weight of magnesium oxide.

The thinner recommended by the makers of the resin can be used to thin the paint to the right consistency.

If the oxide film thickness on the aluminium-zinc-alloy powder approximates to that of the films on 120 mesh B.S.S. powders produced by atomization, flakes with a correspondingly higher electrical conductivity are obtained by grinding with xylene in a ball mill.

Where this is the case plasticized polystyrene may be used as the vehicle in paints having the following composition (A2):—

5 parts by weight of aluminium-zinc-alloy flakes.
2 parts by weight of powdered graphite.
3 parts by weight of plasticized polystyrene (26% solid content).

Xylene or solvent naphtha may be used as thinner.

Commercial aluminium powder (+ 120 mesh B.S.S.) of low oxide content when ground in a ball mill with 2.5% lead powder gives flakes which can be used as the pigment in the following paint (B):—

5 parts by weight of aluminium flakes.
2.5 parts by weight of graphite powder.
3 parts by weight of epoxy cold-cure resin.
0.6 parts by weight of amine-type resin curer.

If the paint does not protect satisfactorily, up to 1 part by weight of magnesium oxide may be added.

This paint will give protection at gaps in the coating or in corrosive atmospheres, such as atmospheres contaminated with sulphur dioxide and corrosive liquids such as seawater and acid rainwater, while in less corrosive atmospheres, it still gives protection provided that the coating is continuous.

Aluminium powder ground in a ball mill with 2.5% lead powder, 25% by weight zinc powder in xylene may be used in the following composition (C):—

5 parts by weight of this mixed metal pigment.
2.5 parts by weight of graphite powder.
3 parts by weight of epoxy cold-cure resin.
0.6 parts by weight of amine-type resin curer.

This composition should be used with a thinner recommended by the manufacturers of the resin. The resulting paint is designed to give protection in many corrosive environments.

A further composition may be made by employing commercial aluminium powder (+ 120 mesh B.S.S.) of low oxide content ground with 25% or more by weight of zinc powder, plasticized polystyrene and xylene

in a mechanical mortar until the powder is sufficiently reduced in size to give a satisfactory paint. Graphite is then added and thoroughly mixed into the paint which is then thinned with xylene to give it the right consistency for painting.

The composition (D) is as follows:—

4 parts by weight of aluminium powder.
1 part by weight or more of zinc powder.
2 parts by weight of graphite.
3 parts by weight of plasticized polystyrene solution (having 26% solid content).

0.5 parts by weight of zinc oxide (which should be free from zinc carbonate) improves the protection in salt solutions and also improves the painting properties. The thinner can be xylene or a mixture of xylene and solvent naphtha. This paint is also designed to give protection in many corrosive environments.

In the various compositions A1, A2, B, C and D the proportions of pigment to graphite may be increased if the oxide content (thickness of oxide film) is particularly low, while the total amount of pigment and graphite is not materially changed.

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